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THE EXPERIMENTAL EVALUATION OF STABILITY INDEXES FOR THE EXTENDED LOAD CAPACITY DUMP TRUCK WITH REAR UNLOADING

The article considers the results of experimental investigations of longitudinal stability and supporting cross-country ability of triaxial heavy-duty trucks with rear unloading for the operation in complicated road conditions while performing transport and charging operations. It has been determined the type of reaction distribution under the wheels of front, intermediate and rear axles in the empty and loaded truck.

Introduction. In connection with a necessity to extend industrial, road and house building, to develop fuel-energy complex and farm-production there is a need in dump trucks. The overall performance of dump trucks depends mostly on efficiency their production equipment construction for unloading.

In order to evaluate stability indexes of triaxial heavy-duty trucks with rear unloading for the operation in complicated road conditions in longitudinal and transverse planes, the investigations have been made for determining of rational modes of exploitation for this type of machinery.

Main part. Experimental research of a pilot model of a dump truck has been carried out in road conditions typical for the exploitation of machinery with various degree of loading.

In order to carry out experimental research there has been prepared a pilot model of extended load capacity dump truck with rare unloading. The main characteristics of this model is a strengthen frame made of high-strength steel channel bars and the availability of inner longeron boosters.

Registration of parameters has been implemented by means of measuring equipment as a part of multipurpose measuring complex "Spidpak" and portable computer.

In the course of tests the following parameters have been fixed:

– static load under all axes of the truck in empty and loaded conditions;

– reactions under wheels of front, intermediate and rear axes of the truck in the processes of unloading.

For measuring reactions under dump truck wheels strain-gauge transducers of vertical loading have been used. They have been installed on plain rigid foundations for accuracy in measurements.

According to the results of reactions determination under the wheels of the left and right rams of a dump truck it has been found out that front, intermediate and rare axes of the empty truck bear 42, 30, 28% of truck weight correspondently.

Analysis of the results made it possible to determine that the load on front wheels comprises 34–35 kH. Reactions under intermediate axle wheels are within the limits of 24–26 kH, under rear axle – 21–22 kH. The obtained results are corresponded to manufacturer data. Inaccuracy of measurements comprised 2–3%.

Mainly, the dump truck is exploited in a loaded state. That's why parameters of longitudinal and lateral stability of a dump truck with extended load capacity are influential for the exploitation in both public roads and in heavy road conditions.

Graph based mapping of deformation devices crossed by a loaded dump truck with cross-country capacity is introduced in Fig. 1.

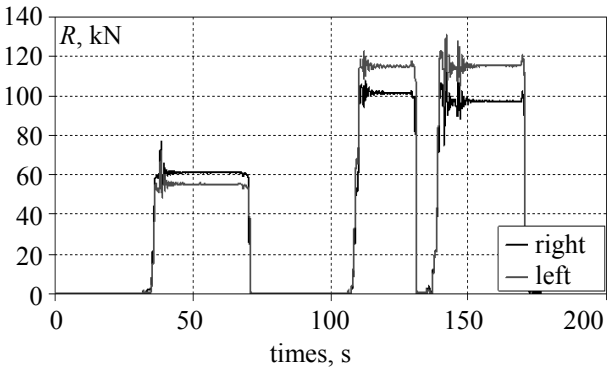

Fig. 1 Graph based mapping of deformation devices crossed by a loaded dump truck

Reactions at transient and steady modes have been registered by means of measuring equipment. At transient modes a sharp change of parameter being registered is occurred , in our case of reactions under wheels.

Steady modes oscillations of the parameter being measured are equal approximately to an average value. For obtaining of more precise values of reactions under dump truck wheels each wheel was on the deformation device not less than 20 s.

Values of dynamic factors when deformation devices being crossed by the wheels of loaded dump truck comprised 1.2–1.4 at the speed of 2–3 kph.

Processing of obtained results has allowed to determine values of loads on an axis of a loaded dump truck and to determine nature of fluctuation of reactions depending on a service platform take-up rate. Determination of reactions was made at

various loading of a service platform. The mass of fully loaded dump comprised about 54 700 kg. Thus it is necessary to mark, that manufacturer recommends the loading of a service platform with loose material with a mass up to 26,000 kg in order to move on public roads. Loadings on front axle have risen in 1.53 times at maximum loading of service platform in comparison with empty truck and comprised 100–103 kN. The load on intermediate and rear axles was within the limits of 212–215 kN on each axle. The load on the intermediate axle has increased in 4–4.5 times, on rear – in 4.8–5 times in comparison with the empty dump truck.

Analysis of the results obtained and their comparison to an acceptable value allows to draw a conclusion that there is a possibility to exploit the tested dump truck on road pavement and open pit with bearing capability of road pavement 100–115 kPa with no limits in load carrying capacity. Moving on roads with lower bearing capability it is necessary to limit mass of transported ground.

A load increment (from 108 to 114 kN) on rare wheels takes place at service platform lift till the moment of ramp opening (Fig. 2). The wheels of front axle are unloaded from 60 till 56 kN.

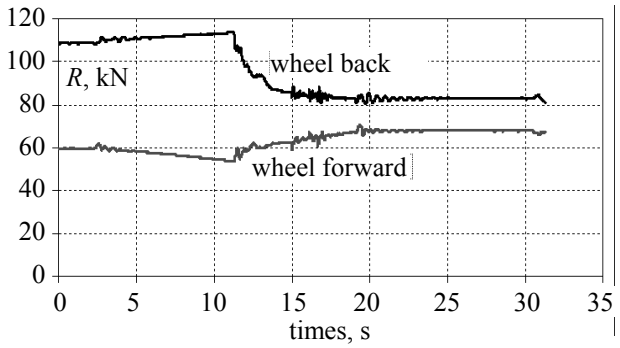

Fig. 2. Changes of reactions under dump truck wheels at the moment of ramp opening

At the moment of ramp opening there is a reallocation of reactions. Wheels of the rear axles are unloaded in 1.37 times, reactions values are within the limits 82–85 kN. Front wheels are loaded less intensively.

Particular interest at unloading processes (operations) introduces Dependency of reaction fluctuations on the wheels of the axle is of particular interest at unloading processes as there is a drop in steerability and maneuverability parameters at considerable unload of front controlled wheels.

According to experimental dependency of reactions changes in front wheel it is possible to single out three typical areas. On the first are (from 0 till 25 degrees) there is a uniform emptying of ground. There is an intensive out flowing of load at service platform inclination 27–35 degrees. At the same time there is a sharp drop of the reaction under the wheels of front axle from 46 till 29 kN. At further turn of a platform (35–50 degrees) the intensity of emptying load is reducing because of large volume of unloaded ground prism which is located behind a dump truck. To provide full unload of a dump truck it is necessary to drive off from unloading place with the lifted platform that will lead to the front axle unload on 10–15% due to significant inertial force and the increased value of height of centre of mass of a dump truck.

Conclusion. Analysis of the results of experimental investigations of longitudinal and lateral stability made it possible to determine that it is necessary to fulfill unloading with inclination towards longitudinal axis of a truck not more than 10–15 degrees, towards lateral axis – not more than 5–8 degrees particularly in winter period at low air temperature, when ground might be frozen to the sides of service platform.

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